

improvement in the rendering into English of the matter already employed. In the direction of chemico-botanical research there is great room for investigation, and a text-book embracing the knowledge already acquired, and information on points in connection with the chemistry of vegetable physiology, would render such a work of interest not only to the scientific chemist or botanist, but also to the general reader. Baron von Mueller's translation forms an excellent nucleus for such a work, and should a future edition of the book be required, we should hope to find it enlarged in such directions.

J. M. T.

### GEOGRAPHICAL ASTRONOMY

*Abriss der praktischen Astronomie, vorzüglich in ihrer Anwendung auf geographische Ortsbestimmung.* Von Dr. A. Sawitsch, nach der zweiten russischen Original-Ausgabe. Neu herausgegeben von Dr. C. F. W. Peters. (Leipzig, 1879.)

AS may be inferred from the title of this work, the astronomical reader will not find it to be a general treatise on the practical branches of the science, but one confined to the theory and uses of instruments, and explanation of methods employed at the present day in the determinations of geographical positions. As such the name of its author, Dr. A. Sawitsch, the well-known Professor of Astronomy in the Imperial University of St. Petersburg, will give the work high recommendation in the estimation of the student. The two volumes of the original edition are now incorporated in one, and such modifications as have been rendered necessary by the introduction of new or improved forms of instruments, and refinements of observation and reduction have been introduced in a great measure by the author himself. In the opening chapter we have explanations of the various methods of reckoning time, and the transformation of one into another; the reduction of mean into apparent places, the calculation of refraction and parallax, and the influence of the earth's compression upon the geocentric co-ordinates of points upon the surface, with remarks upon angular measures in general, and upon the astronomical telescope and its adjustment, the microscopes, verniers, level, &c. In the first section, the author treats of the transit instrument, and enters into the various adjustments to which it is subjected, and also describes in some detail the universal instrument of Piston and Martins, and the errors of division to which instruments for angular measures may be liable. The second section is devoted to the determination of latitude and time by measure of zenith distance, of time from corresponding altitudes, &c. The third section enters more fully into the uses and theory of the transit instrument, and likewise describes Bessel's method for the determination of latitude thereby, supplying practical rules and an example. The next section treats of the determination of azimuth, and of the influence of diurnal aberration on the polar co-ordinates of a star. The fifth section contains a valuable outline of the various methods applicable to the determination of terrestrial longitude, including the telegraphic method, the transportation of chronometers, and longitude by observations of eclipses, especially those of the sun, and by lunar occultations.

The reference to the utility of eclipses for longitude-determination leads to an important chapter on Hansen's method for the calculation of the general circumstances of these phenomena upon the earth's surface, and the methods followed by Dr. Zech, in his researches on the historical eclipses; and, as a numerical example, the formulæ are applied to the computation of the circumstances of the total solar eclipse of August 18, 1887, to which frequent reference has been made in astronomical treatises. The data are founded upon the lunar tables of Hansen and the solar tables of Leverrier. Further, we have a discussion on moon-culminators in their application to longitudes, with notices on the methods of Nicolai and Struve, and a fully-worked-out example. The sixth section relates to the reduction of the longitude, latitude, and azimuth of a place to another, both accurately and approximately, and the determination of the distance of points on the terrestrial spheroid, of which the geographical positions are given. There are two supplementary chapters: the one bearing upon reflection-instruments, and of course entering at length into the use of the sextant; the other treating of interpolation, with special reference to the formulæ of Bessel and Hansen.

In the language in which this work originally appeared it would be almost a sealed book in Western Europe. The excellent translation into a language of which every scientific student should, in these days, possess a knowledge, now placed in our hands by Dr. Peters, will be, without doubt, a welcome addition to his means of instruction on an important branch of practical astronomy.

### OUR BOOK SHELF

*A Treatise on Dynamics of a Particle, with numerous Examples.* By P. G. Tait and the late W. J. Steele. Fourth Edition. (London: Macmillan and Co., 1878.)

THE bibliography of this revised text-book is—a first edition in 1856, 304 pages; a second edition in 1865, 363 pages; a third edition in 1871, 428 pages; and the present edition of 407 pages. There are slight alterations in the disposition and amount of the matter in this edition, caps. x. and xi. of the third are put into cap. ix., caps. v. and vi. are contained in cap. v. of the fourth. The position of some of the exercises has been changed. The main features remain unaltered. The revision has had the advantage of Prof. Greenhill's supervision, who has verified (and corrected where necessary) the Examples and has freely introduced the use of Elliptic Functions. There is no need of any commendation for a text-book so well-known. We are, however, very much disposed to think that had Prof. Tait composed the work at a later date than he did, it would have differed somewhat from its present form and have approximated more closely to the *Natural Philosophy* brought out under the joint editorship of Sir William Thomson and himself. The author justly complains that "several sections in which some novelties appear have been translated almost *letter for letter* and transferred, without the slightest allusion to their source, to the pages of a German work. Several other books have obviously been similarly treated. It is well that this should be known, as the English authors might otherwise come to be supposed to have adopted these passages *simpliciter* from the German."

*Familiar Wild Flowers.* Figured and Described by F. Edward Hulme, F.L.S., F.S.A. First Series. With Coloured Plates. (Cassell, Petter, and Galpin.)

SCIENTIFIC books are of three kinds: to inform the

scientific world of some fresh discovery or advance—works of research; to offer a digest, for the information of students, of results already attained—text-books; and to attract to the paths of science the outside public—popular works. The pretty and attractive book before us belongs to the last of these categories, and is, we think, well calculated to gain the end in view. It consists of chromo-lithographs of nearly fifty of our better-known native wild flowers, with two or three pages of gossip talk about each. Of the letter-press not much more can be said than that it is fairly accurate from a botanical point of view, and pleasantly written. The illustrations strike us as unusually good of their kind. They have of course the inherent defects of this mode of illustration, in the absence of half-tones and delicate shades; but the general aspect of the plant is in nearly all cases well and faithfully given, and the drawing is good. The book is a very good one to put in the hands of a child to interest him or her in the wealth of wild flowers which is such a source of delight to all dwellers in the country who have eyes educated to see their beauty.

### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

#### The Telephone

I HAVE just read an article in NATURE, vol. xviii. p. 698, on the history of the speaking telephone, which contains an erroneous statement of facts which happen to be within my own knowledge; so that, in the interest of a truthful history of this discovery, it is incumbent upon me to make a brief statement in regard to it.

I had the honour to be one of the judges at the International Exhibition at Philadelphia, and of the group to whom was confided the examination of instruments of research and precision. In the performance of my official duty I took part in the experiments which first brought the speaking telephone to the notice of the scientific world. Prof. Bell and Mr. Elisha Gray were both exhibitors at that Exhibition. Mr. Gray's apparatus was conspicuously shown near one of the main aisles, with the exhibit of the Western Electric Company, while Prof. Bell's was in a side room in one of the galleries, as a part of the Massachusetts' educational exhibit. About the middle of June, 1876, Prof. Bell came to Philadelphia to give personal explanations in reference to his apparatus, and before any public exhibition was made he stated to me in detail the character of his inventions. He was working at two independent things, the one the multiple telegraph by means of transmitted musical notes, the other the transmission of articulate speech over long distances. I told him that I was present in May, 1874, at the rooms of Prof. Henry, in the Smithsonian Institution, when Mr. Elisha Gray exhibited to us an apparatus for the electric transmission of musical sounds, and I asked him whether his first invention was similar. He said there was some similarity, although each had worked independently, and that there was a dispute as to the priority of invention. While sanguine as to practical results from his multiple telegraph, his great invention was the speaking telephone, which he believed he had discovered, and in respect to which there was no rival claimant. He said the idea came to him from some of the suggestions in respect to sound vibrations made by Helmholtz, and that he had succeeded, after patient research, in constructing an instrument which would transmit articulate speech. To this invention he desired to direct the attention of the judges.

The experiments with the telephones had to be made when the Exhibition was closed to the public, and the first experiments were made by Sir William Thomson and others on Sunday, June 18 or 25—I do not now remember upon which of these two dates. Their Majesties the Emperor and Empress of Brazil were present at these experiments. Attention was first given to Mr.

Gray, and he gave a lengthy account of his experiments, which had resulted in the perfected apparatus which he then exhibited. He gave an explanation of his various instruments in chronological order, and conducted some very entertaining experiments as he proceeded in his discourse. The object which he had in view was to send many messages simultaneously over the same wire by using sending and receiving instruments of different musical notes.

The greater part of the day was given to Mr. Gray, so that insufficient time remained for satisfactory trial of Prof. Bell's apparatus. The judges and the distinguished visitors present did, however, proceed to the Massachusetts gallery, and Prof. Bell explained briefly his two inventions, and some experiments were made with his speaking telephone, enough to excite the curiosity of those present in the highest degree. The results were so at variance with the views hitherto received that it was determined by my distinguished colleague, Sir William Thomson, to make other experiments, in which I took part. These experiments were made two or three days later, in the building known as the Judges' Pavilion, in the evening, after the visitors had left the grounds. Prof. Bell had returned to Boston, and was not present at this trial of his apparatus. It was brought over to the judges' pavilion, at my request, by Mr. Hubbard, one of the officers in charge of the Massachusetts exhibit, and the experiments were made by Sir William Thomson and myself. Every precaution was taken to make an impartial test. I was at the transmitting instrument which was placed out of doors at a distant part of the building, and Sir William Thomson was at the receiving instrument in a distant room in the building. After some experiments to find the pitch of voice which would suit the vibrating membrane then used, I received word by messenger from Sir William that he could then hear distinctly, and accordingly the pitch of voice then used was maintained in the subsequent trials. I held in my hand a copy of the *New York Daily Tribune*, and I began to read to him items from its news summary, and soon the messenger came to tell me that the messages were heard distinctly at the other end. The longest message which I sent was the following from that paper:—"The Americans of London have made arrangements to celebrate the coming Fourth of July," and the messenger brought me back from Sir William Thomson the exact repetition of the message. Thereupon we exchanged places, and I could not only hear distinctly the utterances of my colleague, but I could even distinguish the ictus of his voice. The results convinced both of us that Prof. Bell had made a wonderful discovery, and that its complete development would follow in the near future.

The news of these successful experiments soon circulated freely, and the day following, or possibly two days afterwards, Mr. Gray came to me and inquired whether the reports of our success with Bell's telephone were correct; and upon receiving from me an affirmative reply, he said that it was impossible, that we had been deceived in some way, that the transmission was by actual metallic contact through the wire, and that it was, to use his own words, "nothing more than the old lover's telegraph." In reply I said to him that we had taken every possible precaution against error, that we were both convinced of the reality of Bell's claims, and that Sir William Thomson would report to that effect. He persisted in his statement that the result was impossible, and that we must have been deceived in some way or other.

After having had direct knowledge of Mr. Gray's views at that time, I must confess to some astonishment at his claim now made that he anticipated Mr. Bell in the invention of the speaking telephone. Several months ago I saw an article in *Scribner's Magazine*, by Mr. Prescott, in which, while no direct assertion was made that Mr. Gray was the first inventor, there were illustrations given to show the development of the invention in chronological order, and Mr. Gray's instrument was there given priority. I had it in mind then to write a note to Mr. Prescott upon this subject, but I feared that there might be unpleasant controversies over the patents, and the claim of Mr. Gray being rather indefinitely stated, I held my peace. But now that the error appears to be taking root, I have felt it to be my duty to make the statements above given. I have before me a letter from Mr. Bell, dated at Boston, Wednesday, June 28, 1876, and directed to me at Philadelphia, in which he gives diagrams showing how we might arrange the apparatus to transmit articulate speech, as he believed, from Boston to Philadelphia, and proposing experiments to that end if the judges should so desire.

In conclusion I ought to state further, that after Sir William Thomson's address at Glasgow had brought the telephone into